

Work Plan

1998 Waukegan Harbor and Lake Michigan Surface Water Sampling Waukegan Manufactured Gas and Coke Plant Site

Introduction

This is a work plan for collecting surface water samples from Lake Michigan and Waukegan Harbor. The purpose of this sampling is to provide background data and a baseline of data for surface water quality for the Waukegan Manufactured Gas and Coke Plant (WCP) site. The proposed surface water sampling locations are shown on Figure 1.

The parameters of interest in the surface water sampling are:

- Arsenic
- Phenols
- Ammonia nitrogen

Other parameters are also included in the sampling and analysis program for informational, quality control, and data comparability purposes.

Schedule

The sampling work is planned for June 1998. If necessary, a repeat sampling within three months after the initial sampling may be conducted. The sampling program for the repeat sampling would be based on this work plan, modified as appropriate based on the information obtained in the initial sampling.

Surface Water Sampling

Surface water samples will be collected under relatively calm lake conditions. Samples will be collected from an anchored boat with the engine off. Surface water samples will be analyzed for the parameters listed in Table 1. The sampling procedures are described in *Standard Operating Procedures for the Collection of Surface Water Samples* (attached).

The following information will be recorded at each sample location: sample number, sample location (latitude and longitude), date, time (start and end time of purging, volume purged, and

sampling time), weather conditions, sampler name, field instrument(s)—make and model, water depth (direct measurement), and any unusual conditions encountered.

Surface Water Transect Sampling

Surface Water Transect Samples will be collected at the general location shown on Figure 1, with detailed locations shown on Figure 2.

Surface water transect samples will be collected in the area of impacted groundwater discharge. The middle transect will be located directly off the SB-61 to SB-64 line of hydropunch borings in the beach dunes. The other transects will be 200 feet north and 200 feet south of that line. These locations were selected because they are offshore from the body of the groundwater plume, as illustrated on Figure 3. Modeling of groundwater flow shows that, for the range of groundwater and aquifer conditions likely for the WCP site, there is a limited zone of impacted groundwater discharge. Most of the groundwater in the lower 5 feet of the sand unit discharges in a zone that lies parallel to and 40 to 250 feet out from the shoreline. Modeling of groundwater flow shows that groundwater discharge beyond that zone would be highly attenuated, and would be of little consequence to surface water quality.

In order to fairly represent the groundwater discharge zone, the transect sampling points are set at 50, 100, 150, 200 and 250 feet from shore. The water in this area is likely to be 3 to 10 feet deep. Surface water transect samples shall be collected 2 cm and 0.5 m above the lake bottom at each location. The sample locations shall be denoted as SWT for surface water transect; a digit for transect 1, 2, or 3; and the distance from shore. Thus, the transect samples will be identified as SWT1-50, 100, 150, 200, 250, SWT2-50, 100, 150, 200, 250, and SWT3-50, 100, 150, 200, and 250. A suffix "A" or "B" will be added to the sample identifier, "A" for the sample at 0.5 m off the bottom and "B" for the sample at 2 cm off the bottom.

Lake Water Sampling

Lake Surface Water Samples will be collected at the locations shown on Figure 1, denoted as SW-1N, SW-2N, SW-3N, SW-4N, SW-5N, and SW-1S. Lake surface water samples will be collected 2 cm and 0.5 m above bottom of the lake. A suffix "A" or "B" will be added to the sample identifier; "A" for the sample at 0.5 m off the bottom and "B" for the sample 2 cm off the bottom.

In areas where the shoreline is beach (as it is adjacent to the site) and the offshore slope is gradual, samples will be collected approximately 100 feet offshore. In areas where the lake bottom

slope is steeper than adjacent to the site, samples will be collected less than 100 feet from shore where the water depth is 10 to 20 feet. In areas where the shoreline is nearly vertical or is breakwater, samples will be collected as near to shore as the samplers deem safe, but not closer than the underwater toe of the wall or breakwater.

Harbor Water Sampling

Harbor Surface Water Samples will be collected at the locations shown on Figure 1, denoted as H-1, H-2, and H-3.

Harbor surface water samples will be collected both shallow and deep at each sample location. The shallow sample shall be collected first. The shallow sample shall be collected 0.5 m below the water surface. The deep sample shall be collected 0.5 m above the harbor bottom. A suffix "S" or "D" will be added to the sample identification, denoting the shallow and deep samples, respectively..

Harbor locations shall be sampled in the following order: H-1, H-2, H-3. Harbor locations shall be sampled last, after all surface water transects and lake surface water samples have been collected, or else the sampling tubing will be replaced after completion of harbor sampling. This replacement will be recorded in the field log. Harbor samples will be shipped in a separate cooler from the lake samples.

Surface Water Velocity Measurement

Measurement of the current speed and direction will be taken at each "SW" and "H" sampling location, as well as the 100- and 200-foot Surface Water Transect locations. Current will be measured in accordance with the procedures defined in the *Standard Operating Procedure for Measuring Water Velocity Vector in a Body of Water, Float Method* (attached).

Quality Control

Quality Control Samples

The following surface water quality control samples will be collected:

- Masked Duplicate Samples: One masked duplicate sample from each surface water transect (three samples total), and one masked duplicate sample of background surface water at sample location SW-5N will be collected and analyzed.

- **Equipment Blank Samples:** One equipment blank of the apparatus used to perform surface water transect samples will be collected. The water used shall be deionized water. The blank shall be collected immediately after the volume of water defined in the purging protocols has passed through the system.
- **Trip Blank Samples:** One trip blank will be analyzed for the surface water parameters for each sampling event.

Data Quality Objectives and Data Validation

The data quality objective for field parameters will be Level I Equivalent (Field Screening). The data quality objective for analytical parameters will be Level III Equivalent—the level which provides laboratory analyses using standard EPA-approved procedures, but which does not include the extensive quality control documentation of CLP. As stated in Section 3.5.2 of the 1991 Quality Assurance Project Plan, Level III provides data for site characterization, environmental monitoring, confirmation of field data, and engineering studies. Routine data validation will be performed, which consists of:

- Holding times and units check
- Completeness check (comparison with requested analysis)
- Precision check (masked duplicate comparison)
- Accuracy check (lab blank review)

Data Reporting and Evaluation

A letter report will be prepared showing sample locations, tabulated data, the outcome of the data evaluation, and recommended changes to the sampling program for future sampling events if deemed necessary. The report will be submitted within three months after completion of the sampling activities.

The purpose of the sampling is to provide background data and a baseline of data for surface water quality. To that end, both the individual data and statistical summaries of representative data will be presented.

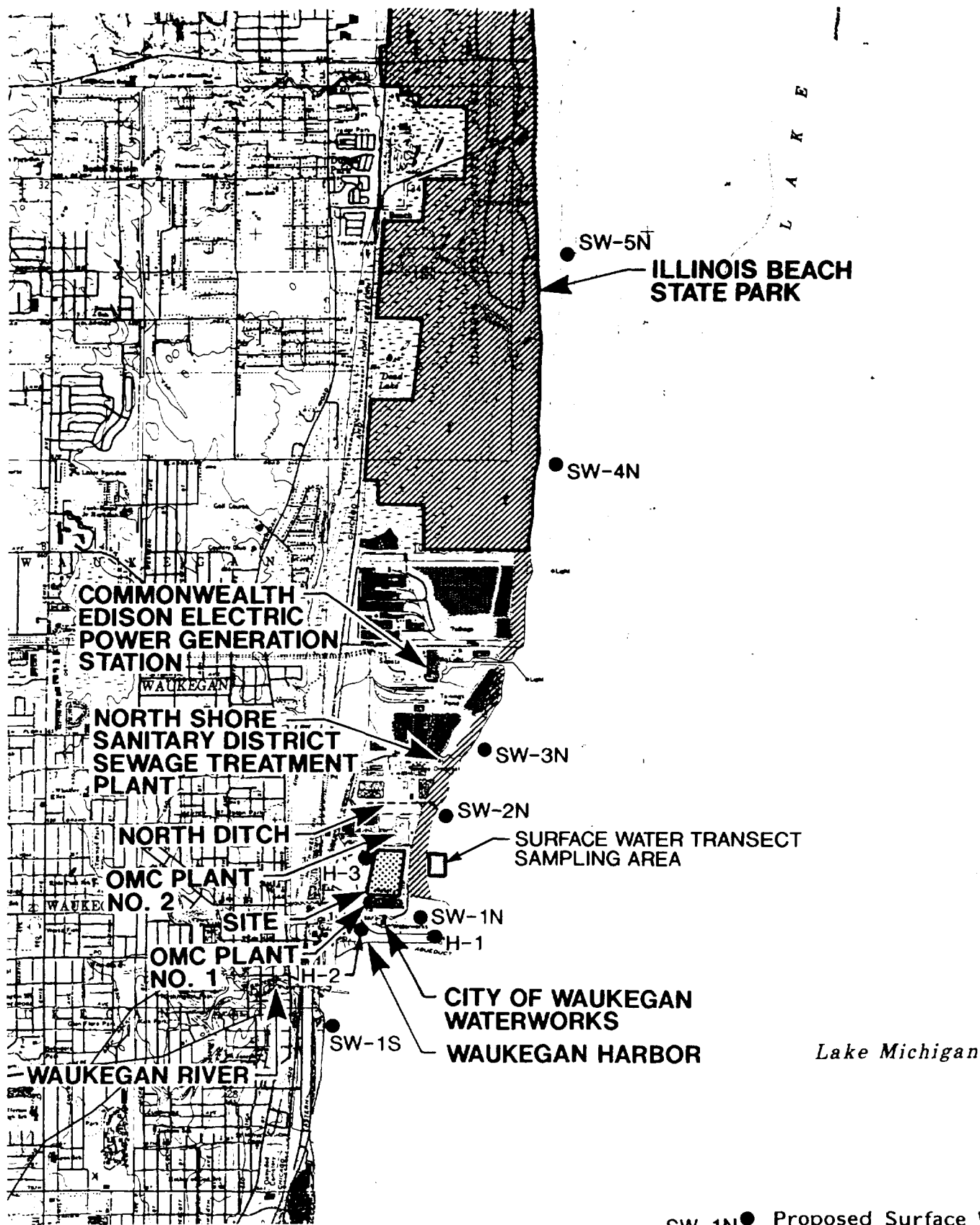
The individual surface water sample results (transect and most of the SW series) will be compared to the Open Waters of Lake Michigan Water Quality Standards (Open Waters Standards). The harbor and swimming beach sample results (H-1, H-2, H-3 and SW-1N) will be compared to the

Lake Michigan Basin Water Quality Standards (Harbor Water Standards). Statistical summaries of background samples, harbor samples, and transect samples will be prepared. For the background samples, the mean, the maximum and the upper 95 percent confidence limit (95 percent UCL) will be reported as representative values. The background samples are SW-1S, SW-2N, SW-3N, SW-4N, and SW-5N. For the surface water transects, the mean, the maximum, and the 95 percent UCL of the mean of all the samples will be computed as representative values.

Phenols are a special case, as the analytic method for the surface water standard is a nonspecific analytical method: 4AAP. There are many sources of phenol, natural and anthropogenic, contributing to the lake. The WCP site phenols are largely limited to five specific compounds. Therefore, in the case of phenols, two values will be reported for all samples: (1) the 4AAP result from the samples and (2) the sum of phenol, m-cresol, o-cresol, p-cresol, and 2,4-dimethylphenol, which are the phenols reported in site groundwater samples.

Table 1
Parameter List—Surface Water Samples

	EPA Analytical Method	Required Reporting Limit
Analytical Parameters		
Ammonia Nitrogen	350.1	10 µg/L
Phenol (4AAP)	(9066 / 420.)	10 µg/L
Arsenic (total)	6010 / 7060	2 µg/L
Benzene	8260	1 µg/L
Phenol	8270	2 µg/L
m-Cresol	8270	2 µg/L
o-Cresol	8270	2 µg/L
p-Cresol	8270	2 µg/L
2,4-Dimethylphenol	8270	2 µg/L
Field Parameters		
pH		
Specific Conductance		
Dissolved Oxygen		
Temperature		
Current Velocity		



Source: Waukegan and Zion, Illinois Quadrangles, 7.5 Minute Series, 1980.

SW-1N ● Proposed Surface Water Sampling Location

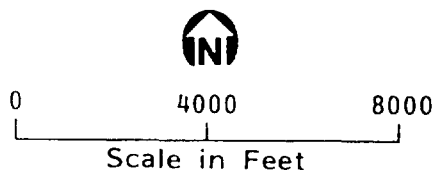


Figure 1
PROPOSED SURFACE WATER
SAMPLING LOCATIONS
Waukegan Manufactured Gas &
Coke Plant Site

LAKE MICHIGAN

200 FEET 200 FEET

SWT1-250 X

SWT2-250 X

X SWT3-250

SWT1-200 X

SWT2-200 X

X SWT3-200

SWT1-150 X

SWT2-150 X

X SWT3-150

SWT1-100 X

SWT2-100 X

X SWT3-100

SWT1-50 X

SWT2-50 X

X SWT3-50

SHORELINE

SB-64 O

SB-63 O

B E A C H

SB-62 O

SB-61 O

MW-13 A



0 100
SCALE IN FEET

- A Existing Well
- O Previous Boring
- X Proposed Surface Water Sampling Points

Figure 2
SURFACE WATER TRANSECTS
SAMPLING PLAN ILLUSTRATION
Waukegan Manufactured Gas And Coke Plant

⊗ SW-01
<0.0014

⊗ SW-02
<0.0014

SWT-1

SWT-2

SWT-3

L-3 ⊙
<0.002

⊙ L-2
<0.002

○ SB-64

× SB-51
0.280

○ SB-63
50.8

○ SB-62
62.7

○ SB-61
21

MW-13 △
- / 0.032 / 0.031 / 0.157 / 0.143
- / 27.0 / 20.5 / 29.0 / 23.8

MW-14 △
- / 0.090 / 0.060 / 0.079 / -
- / 0.760 / 0.630 / 1.10 / -

× SB-52
0.890

× SB-53
0.150

MW-12 △
- / ND / 0.013 / 0.0221 / -
- / 2.60 / 2.00 / 3.01 / -

MW-7 △
- / 0.345 / 0.170 / 0.313 / -
- / 11.0 / 14.0 / 19.0 / -

MW-4 △
0.018 / - / 0.026 / 0.0309 / -
24.5 / - / 70.0 / 59.8 / -

MW-8 △
- / ND / 0.003 / ND / -
- / 0.600 / 3.70 / 8.60 / -

- △ Existing Well
- × 1993 Hydroponic Sample
- 1991 Hydroponic Sample
- Surface Water Transect Sampling Line



0 200
SCALE IN FEET

Figure 3
ILLUSTRATION OF BEACH AND LAKE TRANSECTS
WITH PREVIOUS
ARSENIC CONCENTRATIONS IN GROUNDWATER
AND SURFACE WATER
(Concentrations In mg/L)
Waukegan Manufactured Gas And Coke Plant

STANDARD OPERATING PROCEDURE
FOR
MEASURING WATER VELOCITY VECTOR IN A BODY OF WATER
FLOAT METHOD

PURPOSE: The purpose is to describe the procedure to measure water flow velocity (speed and direction) in a body of water.

APPLICABILITY: These procedures apply to finding the velocity of surface currents in a body of water from a boat under low wind conditions.

REFERENCE: Bureau of Reclamation (1974) *Water Measurement Manual*, 2nd edition, pp. 157-159.

PROCEDURE: A float (an orange) is released from a stationary boat. Distance, time, and compass direction are recorded of the float's position relative to the stationary boat.

All distance measurements are made and recorded to the nearest 1 foot. All time measurements are recorded to the nearest second. All compass direction measurements are recorded to the nearest degree.

To ensure consistent results, the boat is anchored with two or more anchors. Measurements are made in reference to the boat's position. The procedure should only be used under low wind conditions.

- Float
Oranges are used because oranges are slightly positively buoyant, and therefore float at the surface, with most of the orange under water.
- Tape
To measure the distance the orange travels, a 200-foot cloth tape is used. The tape is equipped with floats spaced at 20-foot intervals. The tape is placed in the water prior to release of the orange.
- Clock
To measure the time-distance relationship (velocity) of the orange, a clock with a second hand is used. The time the orange is released is recorded and time and distance measurements are recorded at 10-minute intervals thereafter. If the velocity is rapid, time distance recordings are recorded at shorter time intervals. Time is reported in actual time and lapsed time after release of the orange.
- Compass
To measure the direction the orange had traveled relative to the boat, a compass is used. The compass direction is recorded with each time distance measurement. Compass direction is reported in 360-degree azimuth values.

STANDARD OPERATING PROCEDURES
FOR THE
COLLECTION OF SURFACE WATER SAMPLES

PURPOSE: To describe the collection of surface water samples.

APPLICABILITY: This procedure applies to the collection of surface water samples by the sampling technician(s).

Surface Water Sample Collection

Surface water samples are collected with an ISCO P-150 peristaltic pump equipped with 5/8-inch O.D. medical grade silicone pump house tubing (drive tubing). Surface water is drawn through 3/8-inch I.D. vinyl PVC tubing which is equipped with a weighted end which supports the tube intake approximately 2 cm off the bottom. The intake end of the vinyl PVC tubing is fitted with a stainless steel debris strainer with 100 micron openings (such as the pre-filter supplied for personal water filters made by Sweetwater Inc., or approved equivalent available in sporting goods stores).

The vinyl PVC tubing with weighted intake will be lowered from an anchored boat with the engine off. Approximately 40 feet of vinyl PVC tubing will be used to ensure the intake remains stationary once placed on the lake bottom.

RESPONSIBILITIES: The technician(s) are responsible for the surface water sampling at any and all applicable locations.

PROCEDURE:

Surface Water Sample Collection

Surface water samples are collected from the flowing water (The flow-through stabilization cell is bypassed after stabilization readings have been collected, so that the surface water sample does not contact the flow-through cell).

- Allow pump to continue to run after purging is complete.
- Collecting VOCs requires the slowest possible flow rate for the ISCO P-150 peristaltic pump. This will prevent aeration of the volatile compounds.
- Adjust flow rate to less than 200 ml/minute for sample collection. This will avoid agitation and prevent fine-grained particles from being collected in the sample.
- Care should be taken not to disturb the bottom sediments.
- All unpreserved sample containers will be rinsed three times with sample water prior to collection as a precautionary measure to be sure containers are uncontaminated. Preserved sample containers should be filled from a separate sample container that is rinsed and filled following the procedures for the collection of unpreserved grab samples.

- Caution will be exercised in filling preserved containers to prevent loss of the preservative.
- Filtered samples will be collected using a 0.45 micron inline filter.
- New hose will be used for each sampling area.

Analytic Sampling

- Put on sampling gloves to protect the sample from skin contact.
NOTE: New sampling gloves should be used for each location.
- Prepare sampling containers by filling out the label with the following information:
 - Project number
 - Location identification
 - Individual collecting the samples
 - Date and time of collection
 - Sample analysis (if required by the lab)
- Remove cap from the first sample container.
- Fill sampling container (do not overfill).
- Continue the process until all sampling containers are filled.
- After all of the samples are collected, place the sample containers in the sampling cooler with ice.

DOCUMENTATION: The technician(s) will document the surface water sampling events on field log data sheets.

**STANDARD OPERATING PROCEDURES
FOR
ISCO P-150 PERISTALTIC PUMP**

Suction lift:	0 to 26'
Purge flow rate:	0 to 500 ml/minute
Sample flow rate:	0 to 200 ml/minute
Power requirements:	Isco 12 volt ni-cad rechargeable or 12 volt RV battery

Tubing and Connector Requirements

The following list is a per well requirement.

- Vinyl PVC tubing ($\frac{3}{8}$ -inch inside diameter, 40-foot length).
- Straight connector (one $\frac{5}{16}$ -inch O.D.).
- Reducing connector (one $\frac{3}{8}$ -inch O.D. by $\frac{5}{16}$ -inch O.D.).
- Elbow connectors (one $\frac{5}{16}$ -inch O.D.).
- Silicone tubing ($\frac{3}{8}$ -inch I.D. by $\frac{5}{8}$ -inch O.D. by 22-inch length).

1.0 Scope and Application

- 1.1 This method covers the operation of the Isco peristaltic pump P-150.

2.0 Isco P-150 Set Up and Operation

- 2.1 Loosen the four thumb screws and remove the housing cover.
- 2.2 Cut a 22-inch section of $\frac{3}{8}$ -inch I.D. by $\frac{5}{8}$ -inch O.D. medical-grade, silicone pump housing tubing (drive tubing).
- 2.3 Place 13 inches of drive tubing in pump housing by rotating cam, leaving equal lengths of tubing protruding from the pump housing.
- 2.4 Secure tubing clamps, replace pump housing cover, then tighten thumb screws.
- 2.5 Connect power supply cord to either an Isco 12-volt rechargeable ni-cad, RV 12-volt deep cycle, or vehicle battery.

3.0 Installation of Vinyl PVC Tubing

- 3.1 $\frac{3}{8}$ -inch vinyl PVC tubing material is required.
- 3.2 Connect a 90-degree elbow to the top of the vinyl PVC tubing. Connect a second section of vinyl PVC tubing, long enough to reach the pump drive tubing, to the horizontal end of the elbow.
- 3.3 Attach a reducer between the silicone drive tubing and the vinyl PVC tubing. This will complete the tubing installation requirements.

4.0 Operating Procedures for Peristaltic Pump

- 4.1 Pump the surface water specific conductance, temperature, and pH stabilize and 30 gallons of water have been purged. (See SOP for stabilization testing for surface water sampling.).
- 4.2 After stabilization is completed, turn pump speed control knob to minimum setting.
- 4.3 Adjust speed control knob to provide desired flow rate. Pumping rate can be determined by using a container marked in milliliters and a stopwatch to time how long it takes for the container to fill with purge water. Changes in flow rate will affect the amount of time required to purge the necessary amount of water from the well. (See SOP for collection of surface water samples.)

STANDARD OPERATING PROCEDURE
FOR
STABILIZATION TESTING
FOR SURFACE WATER SAMPLING

Stabilization tests will be conducted prior to obtaining a surface water sample. Stabilization tests will begin as soon as a consistent pumping rate has been established. The tests will be taken once for every five minutes, and continued until three consecutive tests are within acceptable limits for each stabilization parameter (conductivity, pH, and temperature) and 30 gallons of water have been purged. Conductivity, pH, and temperature are measured in a flow through stabilization cell in line with ISCO P-150 peristaltic pump. Dissolved oxygen may be measured during the stabilization test. Dissolved oxygen "D.O." measurements are not made in the flow through stabilization cell, instead D.O. measurements should be made directly in the water column near the intake point.

A conductivity meter is used to measure the specific conductance and temperature of the surface water. A pH meter is used to measure the pH. This equipment is described below.

- Conductivity Meter

Specific conductance is measured in the field using a conductivity meter. The following instrument or its equivalent will be used for analyses in the field: YSI Model 33 specific conductivity meter.

The meter is a portable, battery-powered, transistorized instrument designated to measure conductivity, salinity, and temperature. It uses a probe consisting of a combined plastic conductivity cell and a temperature sensor. Conductivity measurements made by the meter are not temperature compensated; however, a temperature function is provided on the instrument to aid with calculating corrections. Conductivity measurements will be corrected to 25°C.

The temperature of a sample is usually determined using a conductivity meter that is equipped with a temperature function. The YSI Model 33 conductivity meter has a temperature function.

- pH Meter

Field measurements of pH are determined using a pH meter. The following instrument or its equivalent will be used for the analysis of pH in the field: Orion Research Model 407A pH meter. This meter is battery powered and can be used for a variety of measurements, including pH and eH.

- DO Meter

Field measurements of Dissolved Oxygen (DO) will be made with a DO meter. Measurements will be made with an Orion Model 290A, Orion 97-08 Dissolved Oxygen meter or equivalent. The meter is a battery-powered, self-contained unit intended for dissolved oxygen. The dissolved oxygen ranges are automatically temperature compensated for solubility of oxygen in wastes. DO is measured in parts per million.

Allow the readings to stabilize, then record the specific conductance, temperature, and pH of the sample. The procedure is repeated until three samples display readings within acceptable limits. These acceptable limits are:

Specific Conductance: Readings from 0 to 500 must be within ± 5 $\mu\text{mho/s/cm}$ @ 25°C .
Readings from 500 to 5,000 must be within ± 50 $\mu\text{mho/s/cm}$ @ 25°C .

Temperature: Readings must be within $\pm 0.5^{\circ}\text{C}$.

pH: Readings must be within ± 0.1 units.

**STANDARD OPERATING PROCEDURES
FOR THE
CALIBRATION AND OPERATION
OF THE pH METER**

PURPOSE: The purpose is to describe the use of the pH meter, its calibration, documentation, and readings.

RESPONSIBILITIES: The field technicians are responsible for the use, calibration, documentation of pH readings.

EQUIPMENT:	Orion Model 407A/F	Reads pH 0.1 units
	Orion Model SA205	Reads eH pH 0.1 or 0.01 units
	Orion Model pH60	Reads pH 0.01 units

PROCEDURES: Two-buffer calibration for water analysis:

1. Turn meter on, let warm up three minutes.
2. Connect pH electrode to meter.
3. Place meter in pH mode.
4. Place electrode into calibration solution #1 (7.00 buffer).
5. Let reading stabilize, adjust reading to 7.00, if necessary.
6. Rinse electrode with deionized water.
7. Place electrode into calibration solution #2 (10.00 buffer).
8. Let reading stabilize, adjust reading to 10.00.
9. Rinse electrode with deionized water and place into sample.
10. Read pH off of meter to nearest tenth.

Two-buffer calibration for soil pH analysis:

1. Turn meter on, let warm up three minutes.
2. Connect pH electrode to meter.
3. Place meter in pH mode.
4. Place electrode into calibration solution #1 (7.00 buffer).
5. Let reading stabilize, adjust reading to 7.00, if necessary.
6. Rinse electrode with deionized water.
7. Place electrode into calibration solution #2 (4.00 buffer).
8. Let reading stabilize, adjust reading to 4.01.
9. Rinse electrode with deionized water and place into sample.
10. Read pH off of meter to nearest tenth.

Accuracy requirements:

A properly functioning electrode and meter will have a slope of 90 percent to 102 percent. The slope is checked after calibration using the following procedure:

1. Place meter in slope mode.
2. Read slope.
3. If in range, proceed to take reading; if out of range, these steps are necessary.
4. Check battery, replace or recharge if low.

5. Check pH electrode connection to meter.
6. Clean pH electrode and replace reference solution.
7. Use fresh buffer solutions.
8. Try new probe.
9. Send in meter to be repaired.

Sample analysis:

1. Rinse pH electrode with deionized water.
2. Place electrode into sample.
3. Wait for pH reading to stabilize (1 to 5 minutes).
4. Read and record pH reading to the nearest tenth unit.
5. Remove electrode from sample and rinse.
6. Store electrode in buffer solution or storage solution between sample measurements.

QUALITY CONTROL:

Accuracy of field measurement of pH will be determined by calibration verifications every five samples collected and at the end of the day. The accuracy will be assessed by performing two measurements on two standard buffer solutions which bracket the pH range of the samples. Each measurement will be within ± 0.1 standard unit of buffer solution or the meter will be recalibrated.

Precision will be assessed through duplicate measurements at a frequency of 10 percent or one per day minimum. If duplicate measurement of pH is not within 0.1 pH units for water samples or 0.5 pH units for soil pH samples, the pH meter will be recalibrated.

DOCUMENTATION:

The technician will document the calibration and any pertinent information in each meter's log book. Calibration will be done at the start of the sampling day. Calibration verification will be done after every five samples collected and again at the end of the day. pH values of samples will be written down on the field log data sheets for each sample collected.

STANDARD OPERATING PROCEDURES
FOR THE
CALIBRATION AND OPERATION
OF THE
CONDUCTIVITY AND TEMPERATURE METER

- PURPOSE:** The purpose is to describe the use of the conductivity and temperature meter, its calibration, and documentation and readings.
- APPLICABILITY:** These procedures apply to finding the conductivity and temperature of a water sample.
- DEFINITIONS:** Redline: This is a setting on the conductivity and temperature meter to show if the meter is zeroed and to check the battery.
- REFERENCE:** The Instructions for YSI Model 33 S-C-T Meter, Yellow Springs Instrument Co., Yellow Springs, Ohio.
- RESPONSIBILITIES:** The Environmental Technicians are responsible for the operation, maintenance, and checking calibration of conductivity and temperature meter.

PROCEDURE: Calibration (Daily Verification)

1. Turn meter to redline.
2. Meter warm up (two to three minutes).
3. The meter needle should then be exactly on the redline (located on the far right of the display screen).
4. Adjust the redline dial accordingly to receive an accurate display.
5. If redline malfunctions, change battery.

Calibration of Conductivity (daily)

1. Redline meter.
2. Put probe into conductivity calibration solution (YSI 3167 Conductivity Calibrator, assayed at 0.997 millimho/cm, with a composition of potassium chloride, water, and 0.0002 percent iodine).
3. Check temperature of solution.
4. Check conductivity of solution.
5. Match meter readings with prescribe readings (prescribe readings are found accompanying the solution).
6. Reading should be within 50 μ mhos/cm of the prescribe reading.

7. If conductivity readings do not match:
 - a. Check probe connection to meter
 - b. Change battery
 - c. Clean probe
 - d. Try different conductivity solution
 - e. Replatinize probe
 - f. Change probe
 - g. Send meter to be fixed

Sample Analysis:

1. Rinse conductivity probe with deionized water.
2. Select desired mode (temperature or conductivity).

NOTE: The conductivity model, the user must set dial to desired range of measurement (X1, X10, X100 $\mu\text{mhos/cm}$ range) according to the sample conductivity.

3. Place probe into sample and move it around in the sample to remove any air bubbles inside the probe.
4. Wait for measurement (temperature or conductivity) to stabilize (about one to five minutes).
5. Read and record conductivity measurement and temperature.

NOTE: Conductivity must be calculated to the standardized 25°C.

DOCUMENTATION:

The technicians will document the procedures done in redlining daily and checking of conductivity weekly. This will be written down in the log book for each meter. Any other pertinent information will also be noted in the log book for each meter. The conductivity and temperature readings for each sample will be recorded on the field log data sheets for each sample collected.

STANDARD OPERATING PROCEDURES
FOR
DISSOLVED OXYGEN MEASUREMENTS
ORION MODEL 290A METER, ORION 97-08 DISSOLVED OXYGEN METER

Concentration Range: 0.000 to 19900
Resolution: \pm one least significant digit
Relative Accuracy: \pm 0.5% of reading

1.0 Scope and Application

1.1 This method covers the determination of dissolved oxygen in groundwater.

2.0 Dissolved oxygen measurements are displayed in ppm when the Orion Model 97-08 Dissolved Oxygen Electrode is used with the Orion Model 290A Meter. Follow these instructions for preparing the meter and calibrating the electrode.

2.1 Connect the Model 97-08 to meter and leave electrode mode switch "OFF."

2.2 Disconnect ATC probe.

Note: ATC probe must not be connected to the meter.

2.3 Press the **mode** key until the pH mode indicator is displayed.

2.4 Turn the hold feature (1-2) off.

2.5 Press **measure**. Using the scroll keys, change the temperature value to 25.0°C.

2.6 Press the **2nd cal** key. Enter the value 7.00 and press **yes**.

2.7 Press the **measure** key. The slope prompt, SLP will be displayed in the lower field. Enter 100.0 and press **yes**.

The meter automatically enters the MEASURE mode.

2.8 Turn the mode switch on the electrode to BT CK. Good battery operation is indicated by a reading of 13.40 or greater on the meter.

2.9 Turn the mode switch on the electrode to ZERO. Use the zero calibration control to set the meter to read 0.00.

2.10 Insert the reservoir (funnel) into a BOD bottle containing enough water to just cover the bottom. Insert the electrode, making sure that the electrode tip is not immersed in the water and does not have water droplets clinging to the outside of the membrane. Let stand approximately 30 minutes to ensure water saturation of air in the BOD bottle. This bottle should be used for storage between measurements.

2.11 Turn the electrode mode switch to the AIR position. If measurements are being made at sea level, use the AIR calibration control on the electrode to set the pH meter reading to the prevailing barometric pressure in mm Hg (divided by 100). If the

barometric pressure is unknown, if the elevation is above sea level, or if the sample has a salinity greater than 2 parts per thousand, consult **Table 1** found in the Model 97-08 Instruction Manual to obtain the correct AIR setting.

2.12 Turn the electrode mode switch to H₂O for sample analysis.

**STANDARD OPERATING PROCEDURE
FOR
CHAIN-OF-CUSTODY**

The Chain-of-Custody procedures will ensure that the samples are recorded and tracked from the field to the laboratory. The following procedure applies to all samples collected:

1. Prior to the collection of the sample, label the sample bottle with the information appropriate to that sampling location (e.g., date, sample designation, sampler's name, etc.).
2. Collect the sample in accordance with the appropriate SOP.
3. If a surface water sample is collected, record the type of sample(s) collected and the time they were collected.
4. Assure the integrity of each sample container by either keeping the container in physical possession, keeping the container in view at all times, or storing the container in a secured place.
5. At the end of the sampling event, fill out the Chain-of-Custody form, using the Field Log Sheets and verifying the information with the sample containers in the cooler(s). The following information is included on the Chain-of-Custody form:
 - Project number
 - Sample identification
 - Date and time of collection
 - Container type and number
 - Whether the sample is a grab, composite, or blank
 - Project manager
 - Project contact
 - Laboratory
 - Analysis required
 - Signature of sampler
 - Signature of transferee
 - Date and time of transfer
 - Method of transport
6. Ship the cooler to the laboratory.

STANDARD OPERATING PROCEDURE
FOR
SAMPLE TRANSPORTING

Prior to the collection of samples, the holding times for the specific analysis will be reviewed. Samples will arrive at the laboratory in time to allow the analysis to be completed. Samples will be transported in such a manner to preserve their integrity. Samples will be sent to the laboratory by overnight delivery the same day as they are collected, but in all cases if possible, within 36 hours of sampling.